

Exercise walk-through

24.1

DNA replication: retain one strand in each daughter molecule

International Baccalaureate · IB Diploma · Biology · SL

24.1 DNA replication: retain one strand in each daughter molecule

Name: _____ Class: _____ Date: _____

Total: 10 marks

KEY WORDS DNA polymerase DNA

- semi-conservative replication

Objective

DNA replication: retain one strand in each daughter molecule. Original classroom practice for IB SL; not an official IB paper.

1 Key knowledge and worked examples

■ What would explain this observation?

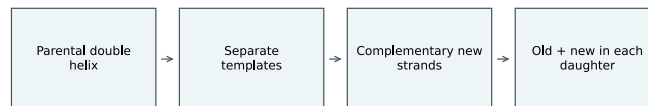
- After DNA replication, each daughter double helix contains one pre-existing strand and one newly synthesized strand. Copying a molecule is different from expressing its information.
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■ **Build the model**

- DNA replication is semi-conservative.
- Complementary base pairing supports copying of the base sequence: adenine pairs with thymine and cytosine with guanine.
- The strands have opposite orientations.
- Helicase separates paired strands, while **DNA polymerase** builds new DNA using a template and available nucleotides.
- **semi-conservative replication** : DNA copying in which each daughter double helix retains one parental strand.

- DNA polymerase: An enzyme that synthesizes DNA using a template.





■ Choose evidence that can test it

- Complementary bases support copying of the template sequence.
- Distinguish DNA copying from transcription into RNA and from separation of chromosomes in cell division.
- The labelled-strand prediction assumes complete replication rounds and no exchange or degradation of the original material.
- Detailed fork direction and fragment mechanisms remain in the separate HL preparation case pending guide review.

In the lab: Use labelled strand models or an attributed experimental diagram. Mark old and new material with both labels and colours so the meaning survives monochrome viewing. Track successive rounds using a stated starting population and assumptions. A classroom model illustrates predictions; it is not direct evidence about enzyme activity or a substitute for experimental results.

■ Work from known quantities

- Known: one double-stranded molecule contains two labelled original strands.
- After one complete round in unlabelled nucleotides, two molecules each contain one labelled strand.
- After two rounds, four molecules exist: two retain one labelled original strand and two contain only unlabelled strands.
- The fraction containing an original strand is $2/4=50\%$.

Your turn: One labelled double helix replicates for three complete rounds in unlabelled nucleotides. What percentage of the eight molecules contain an original strand?

■ Check the conclusion and its limits

- Replication uses DNA as a template to make DNA; transcription uses a DNA template to make RNA.
 - A predicted label distribution assumes complete rounds and no degradation or exchange of the labelled material.
-

Not true: DNA replication and transcription both produce the same type of nucleic-acid product. Replication copies DNA into DNA; transcription copies a DNA template into RNA. The products are different nucleic acids with different roles.

Key:

- DNA replication is semi-conservative.
- Complementary bases support copying of the template sequence.
- Watch for: replication uses DNA as a template to make DNA; transcription uses a DNA template to make RNA.

■ **Write from 12.5 percent still labelled**

- One labelled double helix replicates for four rounds in unlabelled nucleotides.
- Find the percentage of the 16 molecules that still contain a labelled strand. Replication

makes DNA. Transcription makes RNA.

Exercises 2.1·2.2

2.1 What does each daughter double helix retain after one ideal replication round? Choose one answer.

- **A** One parental strand
- **B** Both parental strands together in every molecule
- **C** No parental material

[1]

2.2 One labelled double helix replicates for three complete rounds in unlabelled nucleotides. What percentage of the eight molecules contain an original strand? Show the relation, substitution and units.

[2]

Exercises 2.1·2.2

2.1 What does each daughter double helix retain after one ideal replication round? Choose one answer.

- **A** One parental strand
- **B** Both parental strands together in every molecule
- **C** No parental material

[1]

2.1 A Replication is semi-conservative: each daughter double helix keeps one parental strand paired with one new strand. Keeping both parental strands together in every molecule, or none, contradicts the labelling evidence.

2.2 One labelled double helix replicates for three complete rounds in unlabelled nucleotides. What percentage of the eight molecules contain an original strand? Show the relation, substitution and units.

[2]

2.2 After 3 complete rounds there are $2^3 = 8$ molecules. Two retain original strands; $\frac{2}{8} \times 100 =$

Exercises 2.3-3.1

2.3 Decide whether this claim is true and justify: Replication copies DNA into DNA; transcription copies a DNA template into RNA. [2]

2.4 DNA copying in which each daughter double helix retains one parental strand: write the technical term. [1]

3.1 One fully labelled double helix undergoes 4 complete rounds in unlabelled nucleotides. Find the fraction of molecules with any original strand and explain why original strands do not multiply. [4]

Exercises 2.3-3.1

2.3 Decide whether this claim is true and justify: Replication copies DNA into DNA; transcription copies a DNA template into RNA. [2]

2.3 True. True. Replication copies DNA into DNA; transcription copies a DNA template into RNA. The products are different nucleic acids with different roles.

2.4 DNA copying in which each daughter double helix retains one parental strand: write the technical term. [1]

2.4 semi-conservative replication. semi-conservative replication means DNA copying in which each daughter double helix retains one parental strand.

3.1 One fully labelled double helix undergoes 4 complete rounds in unlabelled nucleotides. Find the fraction of molecules with any original strand and explain why original strands do not multiply. [4]

3.1 Two original strands persist among 16 molecules: $1/8 = 12.5\%$. Templates are retained while new strands are synthesized; assume no degradation or strand exchange. This does not require unsupported SL fork detail.